Rambles among our Industries

PAPER AND PRINTING

WILLIAM J. CLAXTON

Author of "Methodical Nature Study"

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RAMBLES AMONG OUR INDUSTRIES

There was a wise custom of the old trade guilds, the "wander-year", when the apprentice, having served his time, spent a year in wandering from one master to another before settling to his trade. The aim of the wander-year was to broaden the knowledge of the young tradesman and teach him the dignity of his craft. A like purpose has led the publishers to add to their "Rambler" Series a number of books dealing with the main industries of the country. It is well that boys and girls, before passing out into the busy life of the world, should learn something of the reality and something of the romance of the great industries by which that life is sustained.

CONTENTS

COLOURED ILLUSTRATIONS

PAPER AND PRINTING

CHAPTER I

"Rag-a'-Bone"

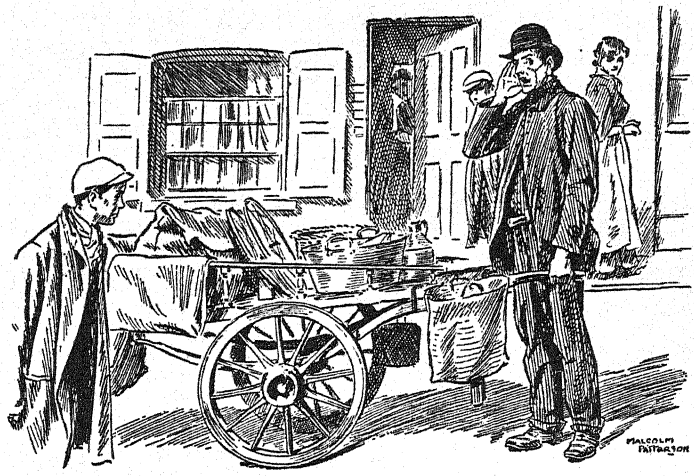
"Rag-a'-bone! Rag-a'-bone! Any old rags or bones to-day?"

What boy or girl has not heard these familiar cries at some time or other? If you live in the busy town, the sight of the ragman pushing his "coster" cart before him must be a very familiar one. Indeed, so regular are his visits in many districts that mother knows when to expect him, and Cissy's worn-out frocks, or Tommy's "cast-offs", are heaped up in the cupboard awaiting his call. What bickering and haggling, too, sometimes take place over the price he is to pay for them! Mother has been saving those rags, rabbit skins, and old papers for weeks, until she thinks there must be a shilling's worth at least. "Penny a pound, ma'am, white rags; farthing a pound, colours!" Nothing will move him to give more. Somehow or other those scales seem to weigh quite different from others, and instead of the shilling, mother is

fortunate to get threepence. He is a hard bargainer. He has some artful people, though, to contend with. Hidden in the heap of newspapers there may be thick brown packing paper. Out it comes! "No sale for this, ma'am!" he remarks. "Trade's none too good as it is, and I must get a living somehow."

And so, off he goes, from door to door. Peasant's cottage and peer's mansion are visited in turn, for what matters where the rags come from! "Rags is rags," he says, with somewhat bad grammar. He does not get his living by correct speech, however, but rather by a keen wit, and a happy knack of striking a bargain as favourable to himself as can be. By nightfall his barrow "goes heavy" as he wearily plods along home. To-morrow another route will be taken, and at the end of the week he will take his sacks to the factory.

But not only in towns does the ragman's trade thrive. Country children eagerly look forward to the sorry old horse ambling along the narrow roads in front of an equally sorry-looking cart. Perhaps the sides of the cart are decorated with paper "windmills" or many coloured balloons. Cannot some of my little country readers remember the time when they were tiny tots, and mother gave them a bottle to take to the ragman? It took you quite a long time to make up your mind over the colour of the balloon, and your sharp eyes soon picked out the strongest windmill! As his visits are far between in the widely-scattered villages, mother has her rags



"Rag-a'-Bone"

sorted into "whites" and "colours". She will get more for them in this way.

But why have I described the ragman and his trade? Simply to show you that one of the greatest industries in the country—the great trade of paper-making—largely depends on his work. Thousands and thousands of books had their beginnings in his dirty old sacks. Of late years many substitutes for his rags have been found. Wood pulp from the Canadian and Norwegian pine woods; esparto grass from sunny Spain or Northern Africa; old ropes, jute, and other articles have all been brought into use; but for the very best paper the old rags, and especially the soft white linen ones, still hold the front place.

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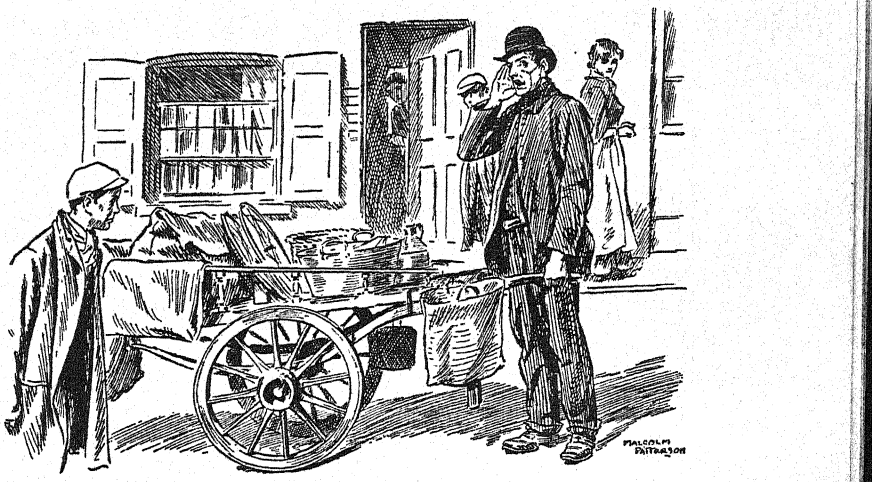

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"Rag-a'-bone! Rag-a'-bone!" And so the old familiar cry still rings out. Summer suns shine on the old ragman, stripped to his shirt as he trudges along with his motley collection; winter winds chill him to the bone as he shivers in the doorway. From youth to manhood, from manhood to old age, he plies his trade. A cheery old chap as a rule! He contributes to our needs, equally with the man who makes the paper, the author who writes the book, the printer who prints it, or the bookbinder who binds it. Whither go his rags? What becomes of them? That is for us to find out in this little book.

CHAPTER II

The Ragman's Lament

There had been a very heavy fall of snow, and, for a brief spell, King Winter reigned supreme, when, one especially severe morning, the old ragman's hoarse voice was heard at the door. It sounded more like a dismal croak than anything else. What could be the matter with the old chap? He was generally so bright and eager for trade. Surely something must be wrong!

Truly the old man looked a pitiful object when we opened the door. His shoes were down at the heel and out at the toes. His clothes hung in tatters, and, as we thought, they were a capital

advertisement for his trade. His ragbag, slung over his shoulder, was almost empty.

"Trade bad this time of the year?" one of us asked.

"Awful, sir! awful! Nothing like the old times! Why, once upon a time I drove my donkey, and turned over three, and sometimes four, 'yellow-boys' (sovereigns) a week. Now!—well, you can see what I've got here this morning. Three hours' work, and bought about two shillings' worth of stuff. Suppose I get double that from it, a profit of two shillings. It's hard to keep a family on that.

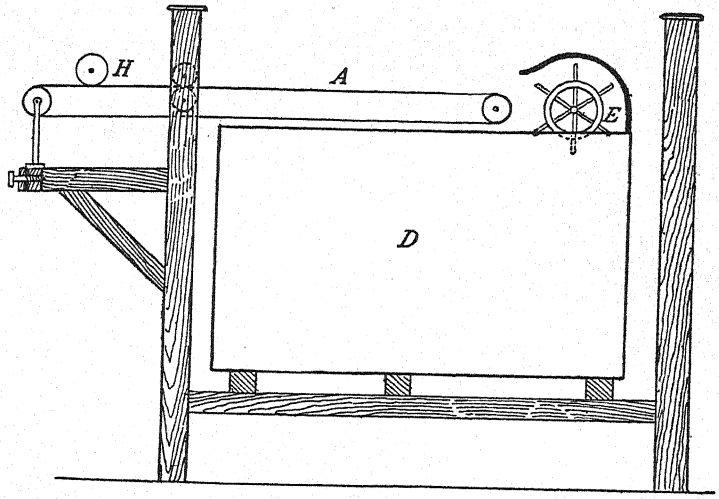
"Things were not always so, though. My old dad made quite a good living, and he was able to put by a little for a rainy day. This gave us boys a good start in the trade, for we are all 'rag-a'-bones'. I remember hearing him say that when they took the tax off paper about fifty years ago he could get almost what he liked to ask for the rags. Paper-making factories sprang up like mushrooms. You see, sir, before then the paper-makers had to pay a tax to the Government on all the paper they turned out; and so it made it dear, and as people do not like to buy dear things there was not a great demand for paper. But when the tax was taken off—in 1861 I think it was—the manufacturers could sell their paper so much cheaper, and the paper trade looked up all round. And, then, that's just where we looked in. At that time they used nothing but rags in the trade, and so

you can see what a rush there was for our wares. The manufacturers were tumbling over each other in their haste to get our stuff. Up and down the country we went, and as we could afford to give the people better prices they were anxious to sell. Six years before the tax was taken off paper, the stamp duty had been removed from newspapers, and so many fresh newspapers were started.

"Ah! we had a glorious time for nine or ten years. The foremen at the factories were very civil to us, I can tell you, for, don't you see, if we failed them what were they to do? I remember going twice a week with dad to the factory, and taking thirty or forty big sacks of rags, all packed as tightly as possible.

"But this great demand for rags during that ten years or so was our downfall. The manufacturers began to look around to see if they could find a substitute for rags, and when a clever man starts putting his 'thinking-cap' on, you know something is going to happen. Chemists tried many experiments with other substances containing fibre, and it was not long before esparto grass, which grows in Spain and North Africa, was used in the paper manufacture. We did not care so much about this, though, for while esparto grass gives about one-half of its weight in paper, rags give nearly three-quarters.

"Now they had made a start in finding fresh materials, it was not likely they were going to stop.



The First Paper-making Machine (see page 31)

The pulp in the vat D was thrown on to the travelling cloth A by the revolving fan E. After being freed from most of its water by the rolls, it was wound on the roll H. It was then removed and dried.

Before long they found out how to turn hemp, jute, flax, and even a kind of straw into paper. Of course, many of the coarser kinds of paper, such as packing paper, and brown paper, were made from these materials; our fine linen rags still held the first place. But the foremen at the factory began to be a bit offhand with us. They shrugged their shoulders and said they didn't care much whether they bought our rags or not; they could get plenty of substitutes. Of course, prices fell at an alarming rate; and as we couldn't give much at the door for the rags, things gradually became blacker because the people would not trouble to sell.

"But the last straw of all was when they found out how to make paper from trees. Horrible stuff it is, too. The Americans use a great deal of it in their books, and many of our newspapers are printed on it. Perhaps it does very well for the newspaper trade, because the paper used in the printing of newspapers is not wanted to last very long, but for books—well, that is quite another matter."

And we believe the old chap would have gone on airing his troubles for hours, but we gave him a few coppers and sent him off. True, he had something to grumble about; but when we came to think things over, we saw that, even though his trade was very poor, yet the great rise in the manufacture of paper had given employment to hundreds of thousands of other people. In nearly every country in Europe materials are cultivated for this large industry. We can picture the French, Russians, Turks, Belgians, and Irish growing the flax, which is now greatly used in the paper trade; the Indians growing jute; the Spaniards cultivating the esparto grass; the Norwegians and Canadians planting the young trees and cutting them down when they have grown up so that wood pulp may be obtained; and the Russians and Turks providing the mills with hemp.

CHAPTER III

In a Lumber Camp

In the last chapter we heard the old ragman speaking very bitterly against the manufacture of wood pulp. To him and his trade it was as "the last straw which broke the camel's back".

Come with me to-day, in imagination, to distant Canada, or let us cross the North Sea to Norway and Sweden. In these countries we shall find immense forests, far larger than the British woods which you, who live in the country, may have wandered through in search of nuts. If we select Norway as one visiting-place we shall have to travel across the country to the east. Most of the forests have been cleared on the west side, as this lies on the sea, and is nearest to Britain, which buys a great deal of Norwegian timber.

The trees in these enormous forests will differ, as a rule, from those in British woods. Instead of the rugged old oak, elm, and other common trees, we shall find enormous belts of pines and firs. Boys who live in Norfolk or Hampshire, or in certain parts of Scotland, will have a good idea of a pine wood, as there are several growing in these districts. Those boys like the peculiar scent of the turpentine in the trees, and they often roam about the woods

looking for an extra large cone, a squirrel nimbly running along the topmost branches, or the rabbits

Felling a Douglas Fir, British Columbia

bobbing in and out of their burrows near the roots of the trees.

Let us visit a Canadian forest in winter, when we may come across a lumber camp. Some of my young

readers may have brothers who have left Britain and settled in Canada. In spring, summer, and autumn the settlers are hard at work on their farms in the centre of this huge country. You may have seen photographs of them ploughing the land, or building their wooden cabins. When winter sets in, the weather in Canada is very cold indeed, and Jack Frost takes such a strong grip of the land that all work, other than feeding the cattle, is at a standstill. The usual plan then is for several farmers to herd all their cattle together, and employ a man to look after them for two or three months, while they earn money by lumbering, or cutting down trees.

Have you ever seen a tall tree being cut down? There seems to be a fascination about tree felling, and if the trunk had been nearly cut through and the tree was ready to crash to the earth, nothing would prevent you from staying to see it, however late you might be for your work. How eagerly you watch the blows of the axe on the trunk, each blow cutting farther into the heart of the old giant, until his body trembles more and more! At last the long rope, fixed to one of the topmost branches, and pulled by several brawny arms, causes the upright old sentinel to bend. He is in his last death struggles! Still the merciless blows rain on him below. More and more he bends; men fly away in all directions; and the mighty pine measures his length on Mother Earth.

Such sights as these are quite common in a lumber

camp. The trees are felled with an axe or a double-handed saw. As a rule both are used, for, should the workmen try to use the saw alone, the weight of the tree would prevent it slipping through the wood. One disadvantage in felling a tree with an axe is that a valuable part of the trunk is wasted, as the axe cuts away so many chips.

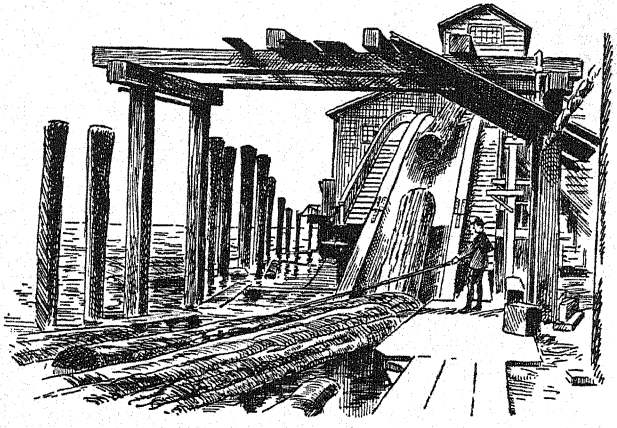
The trees most suitable for turning into wood pulp, and from wood pulp into paper, are the spruce, Scots pine, aspen, and poplar, and their value lies in the order named. After the workmen have cut down the trees, they strip off the branches and cut the trunks into convenient lengths. Each log is marked with a special mark, much in the way that sheep are branded.

Should a river be near, the logs are drawn on a sled by horses down to the river bank, and there they are banded together into a raft. The rafts are often very large, so that small huts may be built on them, and men, boys, and dogs can walk about on them as they move slowly down the river. There is always one man at least on a raft to steer it. For if the raft be left to float down-stream of its own accord, it would probably come into contact with several others belonging to other people, and a "jam" would take place. In such a case numbers of rafts might become so tightly fixed together that nothing would move them and they would form a bridge across the river.

You must not imagine that rafts float down a river as quickly as a boat sails along it. In the first place

the head of the raft, being broad, cannot "cut" the water as the sharp bow of a boat does, and it cannot be steered as easily as a boat. Often it gets stuck on the sides of the river, and it takes a long time to push it off. Some of the rafts may have to float four or five hundred miles before reaching the mills.

Most of the trees on the banks of rivers in Canadian forests have been cut down, and sometimes the lumber camp is many miles from a river. Should this be the case the logs are fixed together on the sleds, where they wait until a heavy fall of snow takes place, when they are dragged by horses down to the stream. When they arrive at the sawmills they are stripped of their bark, their knots are taken out, and they are divided into short lengths, after which they are cut by powerful machines into chips and then made into pulp.



The Logs, after their long journey, entering the Mills

CHAPTER IV

Gathering Esparto Grass

Esparto Grass

To-day we will visit sunny Spain, the land of oranges and almonds. Here we will wander to the dry sunny places near the seacoast in the south and west, or the hot barren table-lands in the centre.

In some of these places we shall see a coarse kind of grass growing up about three or four feet high, and looking very much like the ornamental feather-grass which many of your fathers grow in their gardens. This is the famous esparto grass, now largely used in the manufacture of book paper.

Let us look closely at a piece of esparto grass. It has round stems, similar to those of ordinary grass, only much larger and coarser. The stems are covered with a kind of short hair. When young they are used as

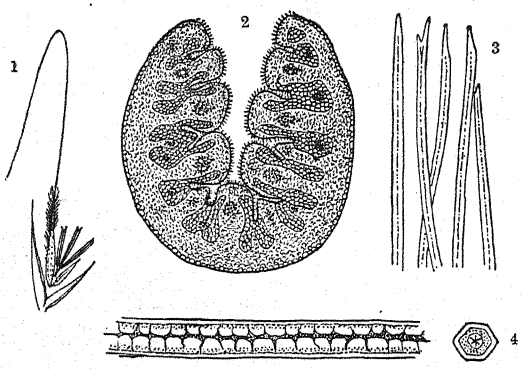
food for cattle, but after they have become fully grown they are far too coarse. The grass grows in patches of about eight or nine feet in diameter. The leaves are of a light-green colour. They are very tough and fibrous, and measure anything between half a foot and three feet in length. About fifty years ago it was discovered how to make pulp and paper from these leaves, and since then there has been a great demand for them in the paper mills. Before this discovery the Spaniards made the leaves into baskets, mats, and ropes.

Should we go to the esparto fields in summer we might see some swarthy-faced Spaniards plucking the leaves from the stems. A quick jerk of the hand severs the leaf from its stalk, and the Spaniard puts it in a big basket which he carries. Years ago the whole plant would have been pulled up by its roots, or broken off at the lower part of its stalk, but there has been such a great demand for the grass that nowadays the leaves are plucked, and the plant brings forth fresh leaves next year.

If the Spaniard works hard he will be able to pluck from two to three hundredweights of leaves in a day. He is told to pull the leaves of those plants which are not quite ripe, but when his master is not looking he sometimes strips young and old leaves off together, although the latter do not make such good pulp.

After the leaves have been plucked they are packed together into huge round bundles about

three feet in diameter. These bundles somewhat resemble trusses of hay, except that they are round and the trusses are square. The bundles are secured by strong ropes wound round them about a dozen times; and they are sent down to the seaports ready

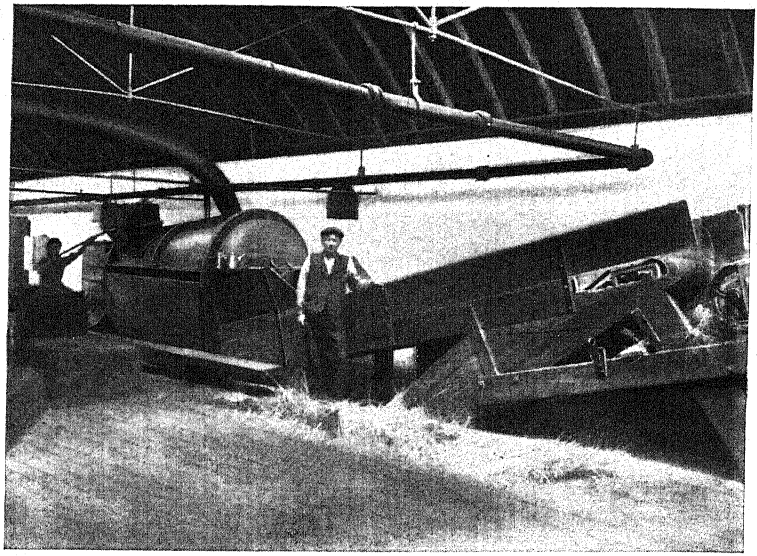


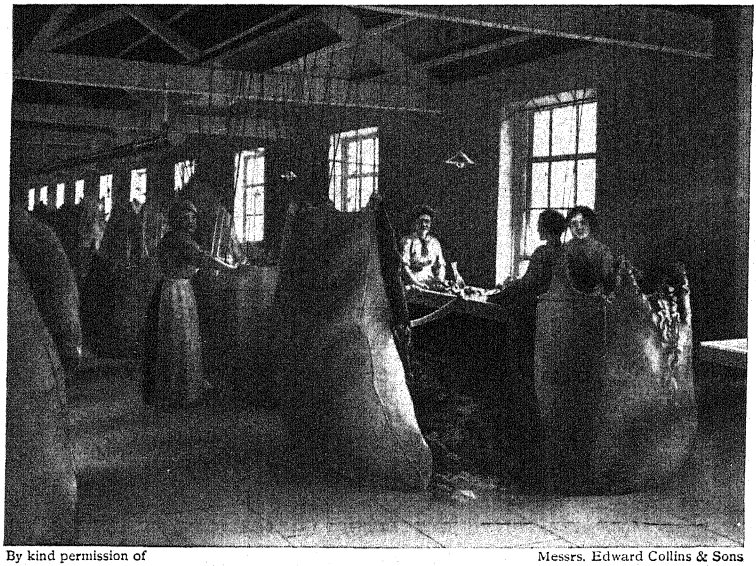
Magnified Details of Esparto Grass

1. Flower. 2. Section of leaf. 3. Portions of fibre.
4. Longitudinal and transverse sections of fibre.

for shipment to the paper mills. When made into paper the grass gives about one-half of its weight in paper. So two tons of grass would produce about one ton of paper.

Great Britain buys about 200,000 tons of the grass every year. Years ago nearly all our esparto grass came from Spain, but we obtain most of it nowadays from Algeria, Tunis, and Tripoli, countries on the other side of the Mediterranean Sea. The people of these countries call it "Alfa grass".





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VIEWS IN A PAPER MILL

At the top is shown Esparto Grass being cleaned and on its journey to the Boiler.
The lower picture shows the operatives cutting and sorting rags

CHAPTER V

How People Wrote in Olden Times

Before we trace the history of paper it will be well for us to learn how people wrote thousands of years ago; what kind of "books" they had; on what materials the records of their countries have been kept, and so on.

We who have our beautiful books to read; our glossy paper of all kinds on which to write; and our daily newspapers and magazines so cheap that all of us can buy them, find it hard to realize how people managed to get along without paper. Just picture to yourselves what the world to-day would be like if there were no paper. No letters; no reading-books; no newspapers! We should feel lost—utterly lost. The business of the world would be at a standstill.

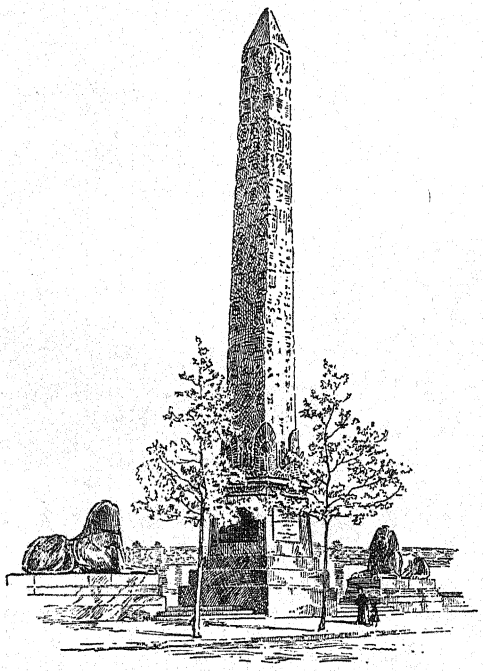
The people of Babylon, long, long ago, used tablets or bricks of clay for writing purposes. With a sharp-edged slip of wood, marks were made upon the clay when it was soft, and then the clay was baked so that it became extremely hard. Some of these clay "books" have been dug up from their earthy beds, where they have been hidden for centuries, and from them clever men have been able to read the history of the very early years of the world.

In these early times, men did not make letters as we do. They used pictures to represent their thoughts. These were pictures of birds, and animals, and trees, and human beings. These pictures were often carved on tall monuments so that everyone could read them as they passed by.

Tablet recording the Wars of Sennacherib, an Assyrian king who lived 2600 years ago.

Every boy or girl who has been along the Thames Embankment in London must have seen one of these ancient picture "books", which we call "Cleopatra's Needle". This monument has a wonderful history. It was first erected in front of a great Egyptian temple. From there it was taken to Alexandria about 2000 years ago, by order of a famous Egyptian queen, Cleopatra. In 1820 the monument was presented to the British, but as it was so extremely heavy and massive, no ordinary ship could bring it across the sea. In 1877 an English gentleman, Sir Erasmus Wilson, had a special boat built for it, and managed to convey it to the place where it now stands. There was very great difficulty in doing so—once the boat was nearly shipwrecked—and the cost of the removal

was over £10,000. As you gaze on this tall pillar, which is about seventy feet in height, you are looking at one of the most marvellous stones in the



Cleopatra's Needle

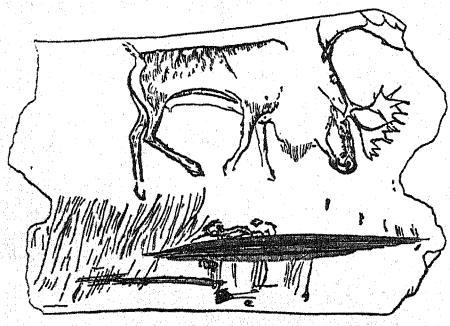
world. It is quite certain you would be unable to read the strange carvings on it, but through the cleverness and perseverance of man these curious marks, or *hieroglyphics*, have been read.

Should any of my young readers ever visit the British Museum when they are in London, they

must ask to see the Rosetta Stone. This stone was dug up from the Egyptian sand by some French officers just over one hundred years ago. It was made of black basalt, and on it was some picture writing, very similar to that on Cleopatra's Needle. Luckily, however, there was a translation of these carvings in Greek, which thousands of people are able to read nowadays. The officers were delighted with their find, you may be sure. It took a long time, even with this inscription, to read the sacred carvings, but twenty-two years afterwards two famous scholars, one of whom was an Englishman, found the clue. Thus an owl stood for the letter m; a lion for l; a knee for k; a reed for e; an eagle for a; a mat for p; a hand for t; and so on.

Another substance sometimes used for writing on in olden times was a potsherd or tile. Have you ever read of the old Athenians and their customs? They had an interesting political device for protecting the state against anyone who became so powerful as to be a danger to the people's liberties. The people would assemble at a certain place at a stated time, and each man was at liberty to write on a tile or potsherd the name of anyone he wished to banish for ten years. If a certain number of votes were recorded against any single man, he was accordingly banished for that time. This process was called *ostracism*, from the Greek word for *tile*, and the word is used in modern speech to denote the cutting off of anyone from society, so that no one will speak to him.

Have you ever written on the laurel leaf? If you make heavy marks on the thick leaf you will not notice them at first, but before long they will be quite clear, and stand out like rusty lines. Many of the ancients wrote on the thick leaves which grew in their countries, and the hollows made by their sharp "pencils" were frequently filled in with soot, charcoal, or some other colouring matter.



Prehistoric Drawing: Reindeer carved on Horn

Most of you have been told that the Ten Commandments were originally written on two "tables" of stone. For very many years these tablets formed the "writing paper" of the Greeks, Romans, and Jews. You can imagine a scribe sitting down to his clumsy tablet, which had been previously coated with soft wax, and making "letters" with a sharp-pointed piece of metal or bone called a *stylus*.

Other writing material was obtained from large flat bones of animals, on which cuts were made by sharp stones and pointed pieces of metal. It is said that the Arabians wrote the history of their great prophet Mahomet on the shoulder blades of sheep.

CHAPTER VI

The First Paper-makers

In two of our chapters we have been travelling, in imagination, to modern countries, where we have seen some of the materials of which paper is made nowadays. To-day we will go back to bygone ages when the first paper was made.

If you were asked: "Who were the first paper-makers?" what would your answer be? Would you select one of the western or one of the eastern countries? As with some other great inventions, the Chinese had something to do with the introduction of paper. Long before textiles were known of in our land the Chinese and Indians had their cotton and hemp fields, and they manufactured the cotton and hemp into articles of clothing. For thousands of years the little Chinese were the cleverest people in the world. Nowadays we do not think a great deal of them. Some boys and girls imagine they smoke opium all day long, grow tea, wear pigtails, take little jerky steps, and have tiny feet. Perhaps western countries have advanced more rapidly than their country has done, but in many ways they are still a very clever race of people, and they are going to play a great part in the world again.

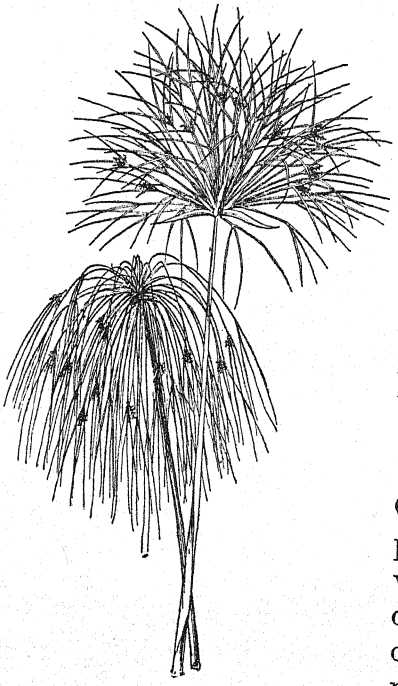
It is rather doubtful who really began the manu-

facture of paper as we know it to-day, but nearly everyone who has studied the subject very carefully gives the Chinese the credit of it. We are told that they took the down of the cotton plant, boiled it in water until they made it into a thick pulp or paste, and set it to dry and cake in bamboo moulds. This took place about two hundred years before Christ was born, or some time before the Romans came to Britain.

Many, many years before this, however, the Egyptians had been making a kind of paper from the papyrus plant. This was a tall plant, often over twelve feet high, which was something like a sedge, and it grew on the banks of the Nile. A large papyrus was more like a little tree than anything else. Its stem was much thicker than your wrist, and it had a very thick skin which was almost tough enough to be called "bark". The stem bears no leaves, but at the top the flowers are in very small spikelets, which grow on a number of little branches forming a crown to the stem. The papyrus is not now found in Lower Egypt, but it grows in the upper Nile districts, Palestine, and other parts.

To make the "paper" the Egyptians stripped the hard thick skin from the stem and then tore thin strips of the stem off in layers, which they laid side by side. Other strips were laid across these, and the whole were made to stick together by a solution of gummy material. After the strips had been bleached by the sun they were ready for use.

Rather poor "writing books" you will say, but they were the best the Egyptians had for quite five thousand years. When they wanted to make a book, one sheet or mat would not be enough, so a number of sheets were fastened together and done up in a long roll. Their "ink" was probably a mixture of charcoal and oil, and their "pen" a reed. One reminder which we have is in the word "paper", which was derived from "papyrus".



Papyrus

For many years the Chinese kept their paper-making secret very well, but at last other nations found it out, and it gradually passed to the western countries. Those wanderers over the earth, the Arabs, brought the secret to Europe about one thousand years ago, and cotton paper was first made in Spain. Instead, though, of making paper from the downy fibre of the cotton plant, it was made from cotton rags, which were shredded and beaten into pulp.

From Spain the manufacture soon spread to surrounding countries, and Italy built the first great paper-making factory in the year 1300. It was a long time, however, before England took to the new trade. In 1495 a man named John Tate built the first British paper factory at a small town not far from Hertford, and in 1588—the year the Spanish Armada came to these shores—some very large paper mills were set up at Dartford in Kent by Sir John Spielman, who was a German.

There was not a great demand for paper in these early days. For then there were no newspapers, and very few books indeed. Printing was not introduced into Britain until about 1470, and the few books that did exist were written by hand, chiefly by the monks. If you go to the British Museum you can see some of these early books. The striking red letter, called the "Rubric", beginning each paragraph, would attract your attention, as well as the funny little "pictures" drawn in the wide margins of the pages. Very few people could read. Perhaps you have seen a picture of several people sitting around a chained Bible in some church, and listening to a "scholar" reading the Scriptures to them.

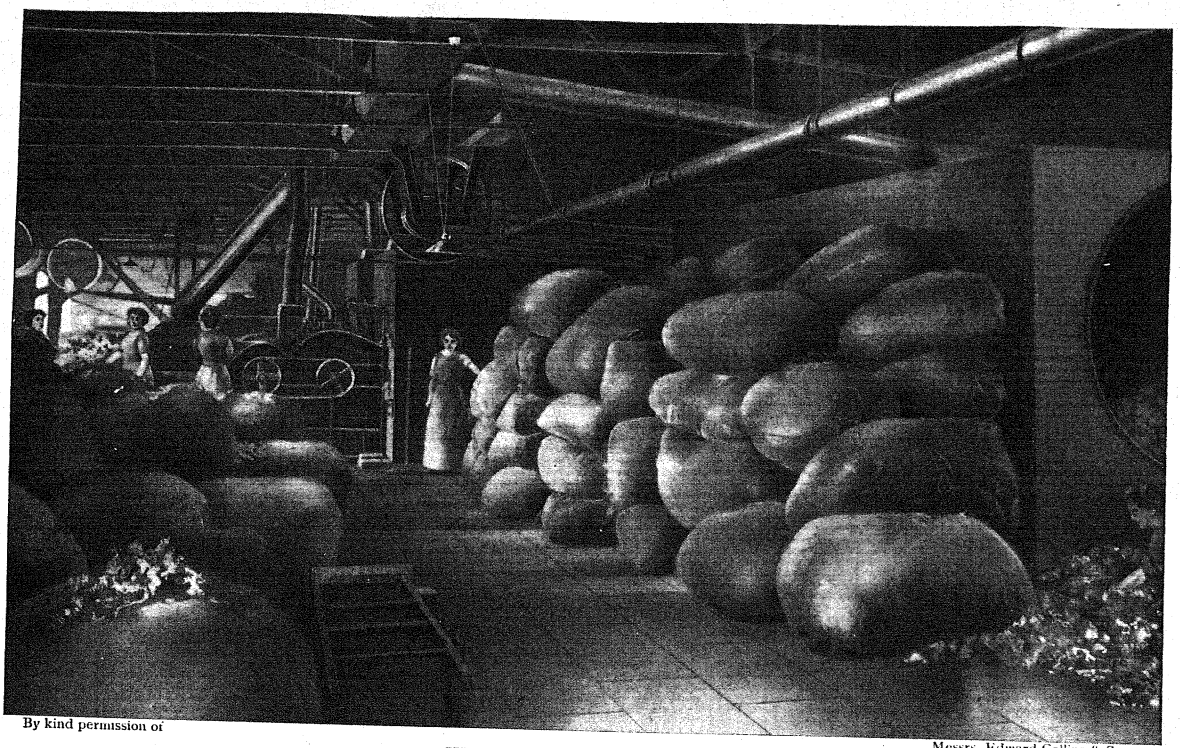
You may have read in your history books that nearly 70,000 French Protestants were driven from their country in 1685, and settled in Britain. Most of these refugees were skilled in some trade or other, and many of them had learnt the trade of paper-making. They practised their trade in the countries

to which they fled, and so many new paper mills were erected, and Britain became one of the chief paper-producing countries in Europe. She has kept this position ever since.

For a long time paper was made entirely by hand, but in 1798 a young clerk in a French paper factory, named Louis Robert, invented a machine which was able to make the beaten pulp into paper. You know that in nearly every trade when machines are introduced the work is done much quicker. The trade, therefore, increases at a very rapid rate, and this was the case with paper. People have not always liked the coming of the machines. In many cases the workmen wrecked the machinery and tried to injure the inventors.

The first machine was a very clumsy piece of work compared with our beautiful modern machines, but it was a good beginning. Other inventors steadily improved the machines, so that we now have machines reeling out miles and miles of paper in an hour.

Wonderful, is it not? If you saw one of these huge machines, quite two hundred feet in length, where the thin watery pulp entered at one end and came out glossy paper at the other end, you could almost imagine you were in fairyland.



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WILLOW AND DUSTER

Note the dirty rags entering the machine at the far end and the cleaned rags being delivered in the right-hand corner ready for the boiling house

CHAPTER VII

Preparing the Rags

Now that we have seen how some of the raw materials of which paper is made—such as the Scots pine, aspen, and poplar, together with esparto grass and rags—have been obtained, we will set off to paper-land.

The paper mill to which we are going is still employed in the manufacture of paper from rags. It has been carrying on this trade for sixty years. But the manager tells us that the work gets less each year, and that he must soon lay down fresh "plant" for the treatment of esparto grass and wood pulp, if he wants to keep up with the times. We learn that whatever the material may be it all has to be made into pulp, but that grass, wood, and rag fibres all require different treatment, and different machines, to do this.

Our walk to the paper mill leads us over a wide marsh, on the other side of which stand a number of buildings which, we are told, are the objects of our search. What would you expect to find all round the mill? Just think for a moment what has to be done to the rags and other materials. What is pulp? How could you make an ordinary piece of paper into pulp?

You will soon see that water is necessary. And so, all round the mill we find water. A river runs round two sides of the group of buildings, and this probably caused the men who erected the paper mill to select this site. Not far from the engine house, noted by its very tall chimney, which towers high up above the surrounding buildings, are four filtering-beds, very similar to the reservoirs which most boys and girls who live in large towns must have noticed. Water from the river enters these filtering-beds, which are really huge tanks made of good clay, and having layers of coarse gravel, coarse sand, and fine sand in the bottom of them. As the muddy water from the river passes through these layers, most of the solid matter is removed from it, and is left behind on the gravel and sand. An engine pumps the filtered water along pipes to the inside of the mill.

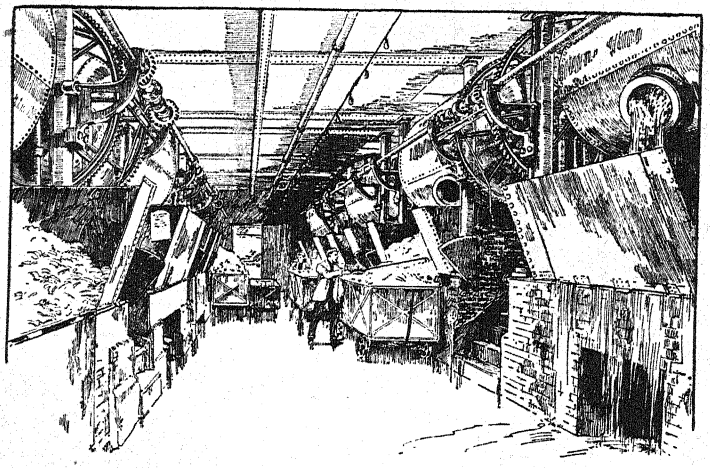
We shall see nothing much of interest from the outside of the factory, and, led by our guide, we enter the building. The first room we come to contains huge bales of rags. There are rags of all sizes, shapes, and colours; as many varieties of rags as there were of rats in *The Pied Piper of Hamelin.* Rags to the right of us; rags to the left of us; rags even up to the chimney. Some of us nip our noses, for there is a kind of fusty smell which is far from pleasant.

A woman rips up one side of a bale and throws the rags into the *dusting engine.* This is a very

large iron tube fitted with cruel-looking spikes, and, when in motion, it revolves very rapidly. As the rags pass along the tube, the spikes dig into them and tear them so that clouds of dust fly out. Some of us think that it must be rather unhealthy work, but we are shown a huge fan which takes away much of the dust.

When the rags have passed through the duster they are sorted into linen rags, cotton rags, and so on. We then notice several benches, before each of which stands a girl about sixteen or seventeen years of age. On each bench a very sharp knife about fourteen inches long is fixed, and the keen edge of the knife faces upwards. The girl takes the pieces of rag and cuts them up into smaller pieces about the size of a page of this book. We are told that in most modern factories the cutting is done by machinery, as hand work, though better, takes far too much time. The girls work very quickly and quietly, and Cissy's cotton dress or Tommy's linen jacket is soon brought into proper size and shape for the next stage.

After the rags have been sized and sorted they are passed into a machine called the *willow and duster*. The former consists of two strong tubes, inside of which are very sharp iron spikes, together with an iron drum which is also spiked. We learn that the machine goes round from two hundred and fifty to three hundred times a minute. Fancy! turning completely round in the time it takes a watch



Rag-boilers

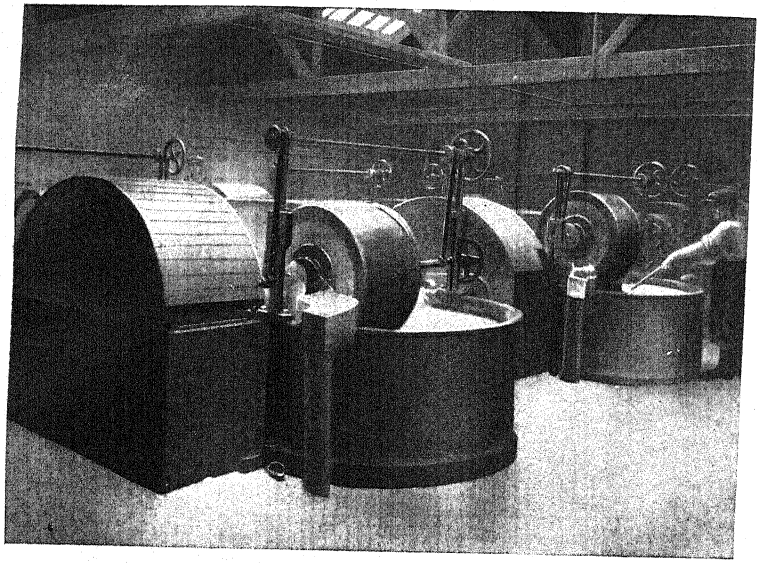
to tick. The duster is a large oblong wooden case containing a kind of iron cage covered with wire-cloth. As the rags are torn and shredded by the horrible-looking spikes of the willow they are passed on to the duster. This slopes downwards from the willow, so that the rags would be thrown out at the other end of it were it not for a kind of large wooden comb which rakes them on to large canvas sheets. These travelling sheets are always moving round and round as the engine is working; and the shredded rags are carried along by them through a hole in the wall to the *boiling-house.*

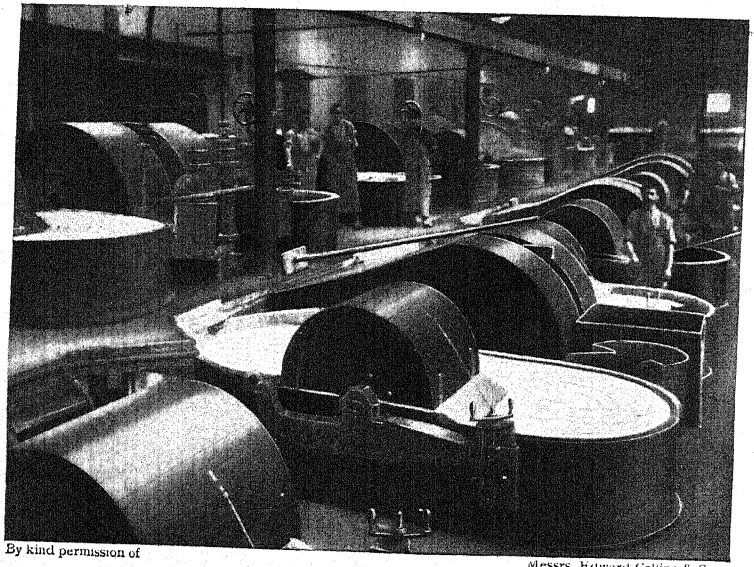
When we enter the boiling-house we are reminded of "washing day", for there is a thick steam around us, and everything reeks with damp. There are

several boilers, each one being about eight feet across and six feet deep. We are told that the base of the boiler consists of a perforated false bottom on which the rags rest, but we cannot see inside, as the manhole is closed. When the boiler was started it was half-filled with water, and a certain amount of caustic soda was added, so that the grease might be removed from the rags. Our guide tells us that great care has to be taken at this stage, as different qualities of rags require different "strengths" of soda.

Most of you would no doubt expect to see large fires under the boilers, but there are none. The water is boiled by steam, which is admitted by two pipes—one at the top, and the other at the bottom. For ten or twelve hours the rags are boiled, and by a special contrivance they are turned over and over, and round and round, so that all of them are brought into contact with the water. This thorough boiling makes the rags very soft, and the fibres flexible. When they have been boiled long enough the steam is shut off, and cold water is turned on. By moving a lever the bottom of the boiler is let down so that the contents are shot into large tubs mounted on wheels. These tubs run them into another building containing the *breaking-engine*.

The next stage in their manufacture is that of pulp-making, and this is, perhaps, the most important work of all.





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MAKING THE PULP

At the top are shown the Breakers making the "half-stuff". The lower picture shows the Beaters making the "whole-stuff" from the "half-stuff"

CHAPTER VIII

Making the Pulp

All the stages of paper-making of which we have already spoken have been concerned with the preparation of the rags for the making of pulp. Whatever article is used in the mill, whether it be hempen ropes, rags, esparto grass, or wood, has to be made into pulp. The pulp looks much like a basin of rather thick porridge, with which my Scottish readers will be quite familiar.

In our last chapter we left the rags being wheeled away from the boiling-house to the breaking-engine. We are told that different factories have different methods of paper-making. In one factory the rags may be bleached before they go to the "breaker", in another this process takes place afterwards.

In this factory the boiled rags went straight to the "breaker". The breaking-engine is a rather complicated piece of machinery. It looks something like a very large tub fitted with huge taps which admit streams of water. The tub is about six feet wide, twelve feet long, and two feet deep. It is half-filled with water and packed with the boiled rags. Inside the tubs there are strong blunt knives, mounted on heavy rollers, and these knives pull and cut the wet rags into fibres. A rather

large drum is fixed in the tub, and this is covered with wire cloth through which the dirty water and other impurities drain away. As fast as the foul water runs away by the drum, pure water is admitted to the tub by a large pipe at the opposite end, and in this way the water is always kept at about the same level. At the bottom of the engine are a number of openings called "button-traps", and in these any stray buttons, or any other hard substances, which had been left on the rags, are deposited.

If you examine a sheet of brown paper you may often see some patches in it. These are probably due to the fact that not all the impurities in the pulp were removed while it was in the breaking-engine. From this you will see that the men in charge of these machines must be very experienced, as pulping is one of the most important stages of paper manufacture.

When the pulp comes from the breaking-engine it is known as *half-stuff*. In some factories the half-stuff is bleached while in the breaker, but this cannot take place before the water taken off by the drum is quite clear. In many cases, though, the half-stuff flows along a pipe from the breaker to the bleaching tank or *potcher*. We notice that the potcher is really a huge brick trough lined with cement, and we are told that the bleaching liquor will cause the pulp to turn quite white. We also learn that the pulp will have to stay in the potcher for twenty-four hours.

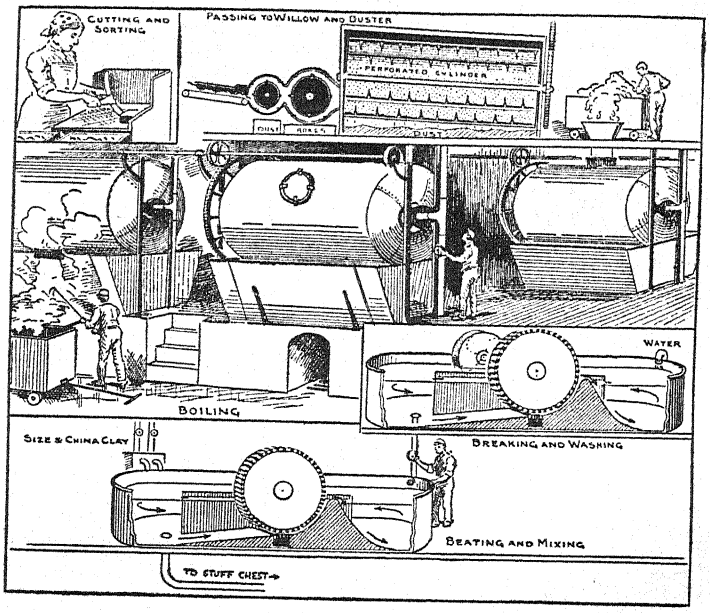


Diagram of a Pulp-making Plant, showing the various operations

There are many different chemicals employed in bleaching pulp. Some mills use one chemical and some another, but different fibres require different bleaching materials. As a rule, well-boiled pulp will lose from one-twentieth to one-tenth of its weight during bleaching.

"Surely the pulp is ready for the paper-making machine now," you will say. This is not so, though. If the half-stuff were made into paper sheets, one part of the sheet would probably be thicker than another part. To make a good paper, all the fibres

must be separated; it will never do to let them mat together. The machine which does this is called the *beater* or *Hollander*. We notice that it is very similar in shape and make to the breaking-engine. It consists of a long oblong trough with rounded ends, and there is a partition down the middle, so that the pulp circulates round and round the beater. At one end is the beating-roll, on which the knives are fixed. This roll is about four feet in diameter.

We think it is very much like the paddle-wheel of a steamer as it goes round and round, and we notice that this causes the pulp to keep on the move. The chief use of the roll is to draw all the fibres out thoroughly so that there will be no hard lumps in the pulp.

Many of you may have used a lawn-mower, and all of you have seen some man cutting grass with one. Perhaps you know that he sometimes raises or lowers the knives. If the grass is very long he raises the knives as far as he can from the plate of iron on which they cut the grass, and which is called the bedplate. If the grass is short, and he wants to cut it as closely as possible, he drops the knives nearly on the bedplate. The "beater" man does much the same thing with the beater-roll. When the engine is started he "puts it down with a light roll", as he says, and he gradually lowers the roll on the bedplate until it is hard down, and bears all its weight on the pulp which is drawn under it. Some of the rolls weigh many tons, and so you will

see that there will be few lumps left in the pulp. It requires great skill to beat the half-stuff into *whole-stuff*, as the pulp is called when it leaves the beater.

The pulp has now reached the stage when it is coloured, should a tinted paper be required. The necessary tint is given by adding different chemicals to the watery pulp while it is in the beater, and causing the pulp to circulate so that every particle of it comes into contact with the dyeing material.

Examine a piece of blotting paper, and also a sheet of writing paper or foolscap. You will notice that one has quite a different "feel" from the other. The blotting paper is "soft", whilst the other is "hard". You know, too, that the former has the power to suck up ink. This is because its pores are open, and the ink runs into them. In the case of writing paper these pores have to be stopped up, by giving the surface a kind of coating. This is done by adding sizing materials to the whole-stuff. Should the pulp be run into the paper-making machine before sizing, the result would be blotting paper. As a rule, though, some starch paste is added to the pulp before it is made into blotting sheets, so that the fibres are felted a little better.

Various chemicals are used in sizing the pulp, but you would be unable to understand them, and the different ways in which they are applied, unless you had a knowledge of chemistry.

You will be surprised to learn that in the sheet

of paper from which you are now reading, there is probably some mineral, such as China clay or lime. The addition of these "loading" materials, as they are called, is made in the beater. Loading gives the paper a smoother surface, and also helps to fill up the pores; and therefore it is often used to make paper as opaque as possible, so that the print on one side of the leaf will not be seen through on the other side. Many papers, however, are wonderfully opaque without containing any loading.

And now the pulp is ready for the paper-making machine at last! "Quite time, too," you will say. We are getting tired of our walk, and our guide's voice begins to sound rather monotonous, as he explains all the mysteries of the various machines. As we look at these machines we cannot help thinking of the very clever men who invented them, and how it has taken years and years of great perseverance to bring them to their present state of perfection. "Slow but sure wins the race" is often said, and in no case is the old proverb more true than in that of invention.

CHAPTER IX

From Pulp to Paper

We have now arrived at the last stage of paper-making, where the pulp is made into large sheets or reels of paper. Nowadays this is usually done by the huge paper-making machines, but in the early days of paper manufacture it was always done by hand. But in whatever way the paper is made the same principle is applied, and that is that the pulp-fibres have to be knitted or felted together.

In the simplest form of felting, the fibres composing the substance to be felted, whether it be wool, pulp, or anything else, have to be pressed and tangled and intertwined so that they form one solid mass.

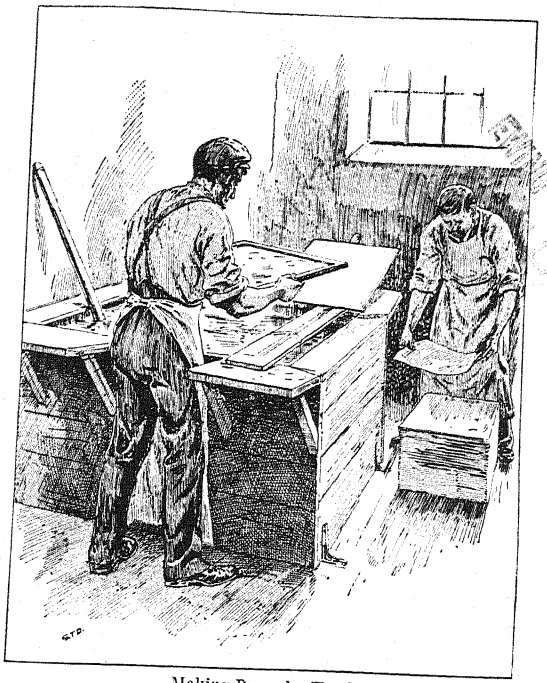
A very pretty little story is told about the discovery of felting. A good monk, St. Clement, undertook a long pilgrimage, and, as most of you know, a pilgrim may have to walk for hundreds of miles. People who walk along hot dusty roads for a great distance sometimes suffer from blistered feet, and before commencing their walk they often put soft socks in their boots or shoes. St. Clement is said to have put layers of carded wool between his feet and the soles of his shoes or sandals, and when he arrived at his journey's end he found that the

heat from his feet, and the pressure upon the fibres, had matted them into a solid piece of felt. Ever since then, St. Clement has been the patron saint of the felt-makers. Felting, however, had been practised hundreds of years before, so that his discovery was not a new one.

Perhaps we had better watch the workmen making paper by hand, before we try to understand how the paper-making machine does its work. We notice that one workman holds in his hand an oblong frame or mould much like a picture frame. The mould is made of wire-cloth, and we see that the man can make the frame any size he likes by moving the wooden border, called the *deckle*, which fits on the outside of the wire-cloth. Like the picture frame, the deckle is slightly higher than the wire, so that any pulp which may be poured on the wire will not run over the sides of the frame.

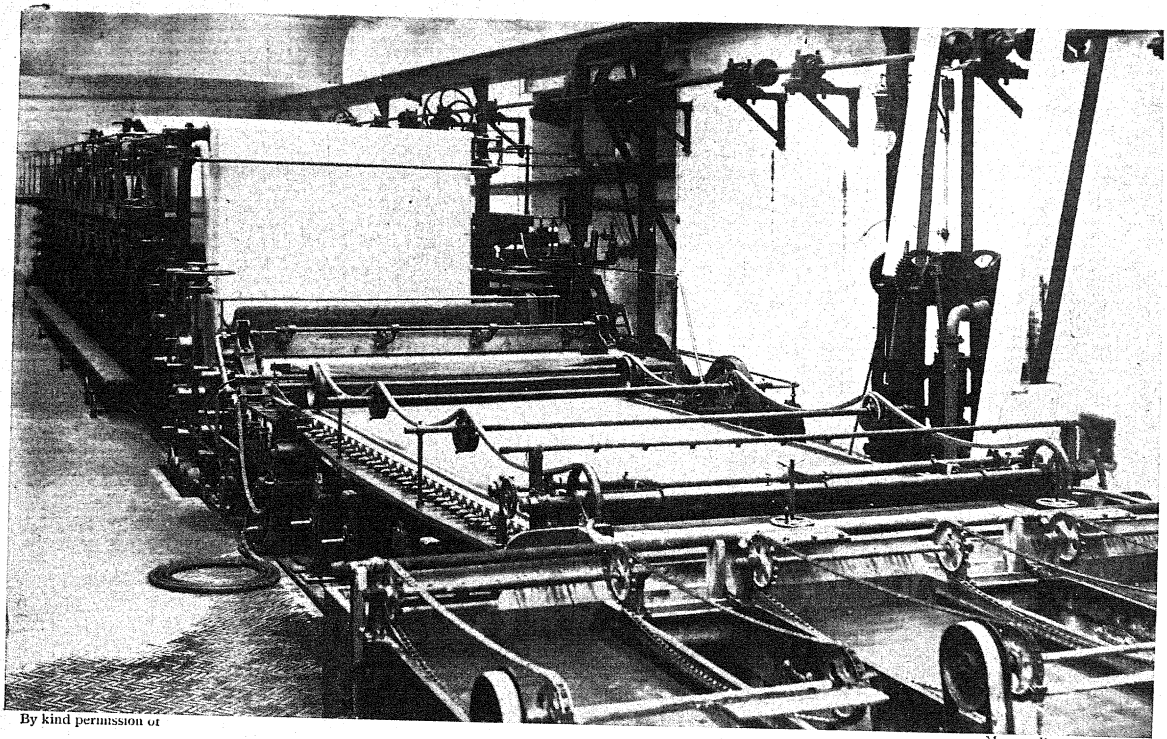
Near the workman are several huge vats called *storage vats*, or *stuff-chests*, and the pulp runs from the beater through large pipes into the vats. In the centre of each vat there is a kind of paddle-wheel arrangement which goes round rather slowly, but which is sufficient to keep the pulp on the move. The workman dips the mould into the vat and lifts up as much pulp as he requires to make the sheet of paper the necessary thickness.

No doubt most of you have seen your mothers or sisters straining some substance through a muslin or flannel sieve. This is done when they are making



Making Paper by Hand

jelly. The currants or plums are placed in the strainer and the liquid runs away through the holes Much the same kind of thing goes on when the pulp is placed in the mould. The water drains away through the wire-cloth, and leaves the fibres behind. We see that the workman gently moves the mould backwards and forwards, or from side to side, and this assists the fibres to felt. After some time the pulp, which now forms a sheet, is handed to another workman, who turns it over on to a sheet of dry



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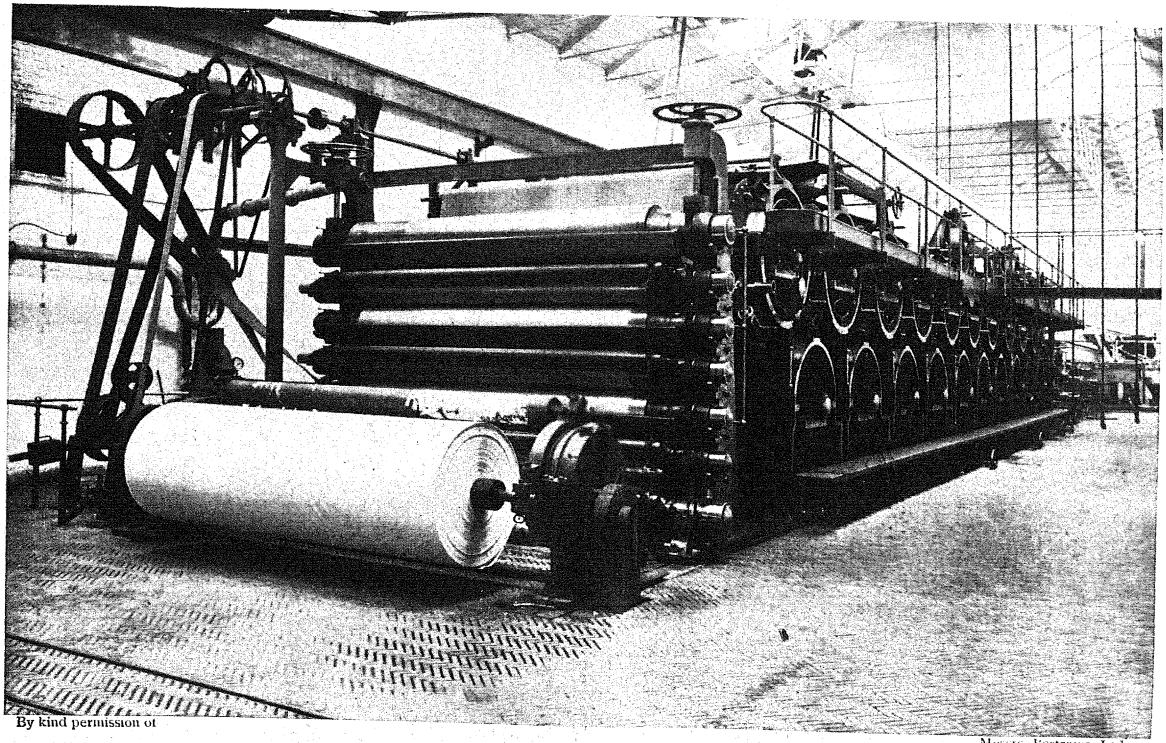
VIEW OF WET END

The wire cloth is 60 feet long and 11 feet wide



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VIEW OF DRY END

A LARGE PAPER-MAKING MACHINE

Working at the *Daily Telegraph* Mill, Dartford. Each of the twenty drying rollers is 16 feet in circumference and weighs over 5 tons

felt. Another layer of felt is placed on the top of it, and then another sheet of pulp, so that, in time, a good pile is obtained. When the pile is sufficiently thick, it is pressed very firmly by a machine, and any remaining water is squeezed out. The felts are then taken out, and the drying sheets are again pressed, after which they are hung up to dry completely. The paper has then to be finished off, after which it is ready for use.

For many years this was the only way in which paper was made, and as the work took much longer by hand than by machinery, paper was rather expensive to buy. Hand-made paper is better, though, than that made by a machine, and the very best paper, such as that required for bank notes, is still made by hand.

If you hold a sheet of notepaper to the light you will see a design of some kind imprinted on it. This is called the *watermark*, and it was formed by the pattern which was worked on the wire-cloth forming the mould in which the pulp was placed. The delicate wires of the design were raised ever so slightly above the rest of the wires, and so the paper is rather thinner in texture where the pattern is impressed. In many cases the watermark shows the maker's name and the quality of the paper, together with the trade mark of the firm. All sorts of curious patterns have served as watermarks, such as animals, birds, flowers, fishes, tools, and coats of arms.

We will now talk about the wonderful paper-making

machine. Day and night it runs, and the chank-chank of the driving rods, together with the whizz and burr of the numerous wheels, would interest you all. Many of these huge machines are quite two hundred feet long. Fancy! A machine as long as three cricket pitches put end to end. At one end of it the pulp runs from the storage vats, and at the other end it is taken away as huge rolls of paper. Not one human hand has touched it in its course. There may be one or two men quietly strolling around the monster when it is working, their trained ears ever on the alert for a sound of something wrong in the machinery. Now and then one of the men oils the parts where there is great friction. The men who work these machines look upon them almost as though they were human. They keep them spotlessly clean, and treat them almost affectionately.

The pulp, after leaving the storage vats, enters the refiners. One of these is a long shallow trough, called a *sand-table*, and along this trough the watery pulp flows very slowly. At the bottom of the trough there is often a layer of woollen felt, and this catches and retains any sandy or dirty substances still left in the pulp. It next enters the *strainers*, where any lumps in the fibres are removed. There are many kinds of strainers, but they all consist essentially of iron plates with extremely narrow slits, through which the watery pulp can pass, while the lumps are left behind.

The pulp should now be sufficiently refined for making into paper. The stuff passes from the

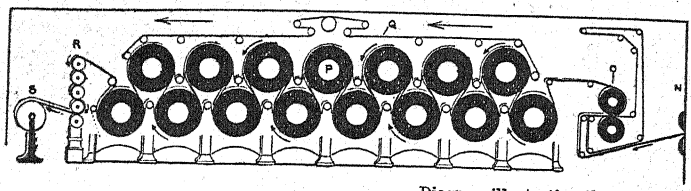
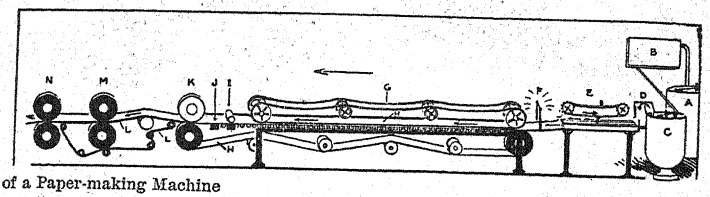


Diagram illustrating the Processes

A. Stuff chest. B. Top chest. C. Mixing box. D. Sand trough. E. Strainers with endless wire-cloth. I. Dandy roll. J. Suction boxes. K. Couch roll. cylinders. Q. Endless flannel band.

refiners to the breast-box of the machine, from which it overflows on to a moving table of wire-cloth. At the sides of the wire-cloth are the *deckle-straps*, which regulate the width of the paper; so you see that the machine, at this stage, corresponds with the mould which the workman uses in making paper by hand. The wire-cloth table is so made that it rocks from side to side, much as the mould for hand-made paper did, and the water drains away through the cloth, while the fibres are felted. The rocking motion, however, is not the same all along the stretch of wire-cloth. Where the stuff enters, it is rocked rather violently, and the rocking gradually becomes less violent as the table nears the other end, until the rocking movement completely dies away. The pulp does not move very rapidly along the wire-cloth. The speed varies from fifty feet to five hundred feet a minute, according to the quality of paper required.

As the water drains away from the cloth it is caught by large tanks, from which it is sent by a pumping-engine to the filter where all the impurities are removed and it can be used again.



of a Paper-making Machine

F. Water spray. G. Endless rubber deckle straps. H. Vibrating table covered L. Endless flannel band carrying paper. M, N, and O. Press rolls. P. Drying R. Calendering rolls. S. Reel of finished paper.

You would be interested in seeing the pulp move along the wire-cloth, and noting how it gradually gets more solid. To extract still more water the pulp goes over the *suction-boxes.*

The watermark is here given by a revolving cylinder called the *dandy roll.* This is covered with raised wires forming the required design, and presses closely on the pulp, or fluid paper as we ought now to call it. The dandy roll is, as a rule, placed between the suction-boxes.

"Surely the paper is finished now," you say. This is by no means the case. It is still very moist, and has to pass through a number of rollers covered with thick felt, where it is mangled, and the water is still further removed. It is next sent round and round a number of rolls heated by steam, and this dries the paper. In some machines there are twenty or thirty *drying cylinders.*

All that now remains is to "finish" the paper. Should it be wanted for writing purposes, or for the imprinting of photographs and pictures, it has to be *surfaced* or *calendered.* The calender rolls are in

pairs like the driving rolls, and you may compare their working with that of a mangle. The friction of the calenders on the paper produces electricity, which frequently discharges by sharp cracks and sparks.

The last thing is to cut the paper into the required sizes and wind it on reels. In the case of paper required for the printing of newspapers the reel often contains a roll of paper five miles long. You may have seen such a roll fastened to one end of a printing press.

If you have the chance, you should go over a paper mill at some time or other. There is law and order everywhere. Each man has his appointed work to do. There is not the slightest bustle or confusion. A huge factory is almost like a number of trades quite separate from one another, and where, possibly, one man may have but a very faint idea of the other men's work. The men are like cogs in a mighty machine, and the smooth running of the machine depends entirely upon how the cogs fit into each other.

CHAPTER X

The Birth of the Book

Now that we have the smooth, sized paper on which to write, we can proceed with our book. We will briefly trace the stages of a book right from its birth in the author's brain, up to the time when it is sent out into the world, ready for us to read.

Perhaps some of you may think the writing of a book is an easy task. You may have tried to compose something yourself, and it is certain most of you have written a letter. Sometimes the sentences will come quite easily. At other times, try how you may, you can make but little progress.

A great writer once said: "Anyone can make a sentence; but everyone cannot make a sentence that is both clear and neat. We all speak and write sentences every day; but these sentences may be neat or they may be clumsy—they may be pleasant to read, or they may be dull and heavy."

The sentences in the books which you read have given much anxious thought to the authors of them. Before a word of the book has been written the author has to prepare a plan of the whole book, just as the builder must have a plan of the finished building before he lays a single brick. He must decide how many chapters there will be. Nice titles for the

chapters must be chosen, and this alone sometimes takes many hours.

In books like this one the writer must go over many factories where he will see the men at work, so that he will be able to describe the machines which they use, and the buildings where the work is carried on. Days and days are spent before the blazing furnaces, and amidst the whirr and clank of the mighty engines and machines. He must keep his eyes and ears well open, and take note of everything he sees. All this and many other things have to be done before one word of a book like this is written.

At last a short skeleton of the book is drawn up on a sheet of paper. This skeleton should always be in small compass, so that it can be taken in at a glance. The author will sit in a quiet room with this skeleton before him and think what he is going to write. Not until the book has been thought out from beginning to end will he put on paper a single word. One of our greatest English writers once remarked: *Sit down to write what you have thought and not to think what you shall write.*

You know when you sit down to write a letter or an essay how hard it is to think of your sentences. If you do not clearly understand all about your subject, you will never make good progress. But however well you understand the matter yourself, the art of writing consists in making your readers understand it. Every sentence must have a perfectly clear

meaning, and every word should be weighed most carefully to see if it is the best possible word.

You should always express your meaning in as few words as you can. The great poet, Alexander Pope, must have been thinking of this when he wrote:

> "Words are like leaves; and, where they most abound,
> Much fruit of sense beneath is rarely found".

After the book has been planned, it is written out, and this writing is called a *manuscript*. The letters MS. are generally used for manuscript. After the MS. has been completed it has to be thoroughly revised, and many alterations are often required. If you saw the revised MS. of some authors, as it goes to the printers, you would be unable to read it, and sometimes the printer, even though he has had much practice in reading all kinds of MS., has hard work in finding the author's meaning. However carefully the book is written, there are bound to be mistakes of some kind or other. For the very best books the MS. is sent to four or five different readers for revision, and all of them find errors which the others had passed over. The MS. is written only on one side of the paper, for the convenience of the printer.

Great patience and perseverance are required by all those who write books. Sometimes your hand is tired and your eyes grow dim even after you have written only one essay. Perhaps this essay has about 500 words in it. If you are tired over this, what would your feelings be if you had to

keep at the same task for weeks and weeks, and write 100,000 words? No one could undertake such a task unless he had real love for his work, and a gift for writing.

Perhaps some of you would like to write a book when you grow up. "Composition" has always been one of your favourite subjects, and your work may have been highly commended. If this be the case you should read the works of the best authors on every possible occasion. Read over and over again what strikes you as finely or nobly written. You may buy any number of books which profess to teach you how to write, you may learn any number of rules, but these will not help you nearly as much as reading the best writers.

At last the manuscript is completed! The clean white pages are carefully numbered and neatly fastened together, ready for the printer. What he does with them we will read in the next chapter.

THE COMPOSING ROOM

Where the type is set and the forme made up ready for the foundry

CHAPTER XI

Setting the Type

When the author has completed his manuscript he sends it to the publisher. Before it goes to the printer, the publisher will have to decide what size the book is to be, how many pages will be required, and what type is to be used. In fact, he will have to plan out the book just in the same way as the author planned the manuscript.

A very important part of the work is to *cast off* the copy. By this we mean the number of lines or pages of type a given piece of manuscript —or "copy", as the printer calls it—will make. This is often very troublesome. Sometimes the manuscript is unevenly written, and many corrections are made. In this case the calculations may be inaccurate. If the author has counted the words, the printer has an easy task in casting off copy, but many authors rarely do this.

If it is intended to have illustrations in the book, the publisher will have to calculate the number of pages required for these. These and many more points must be carefully considered. Before a single word is put into type, the printer will have a plan of the book in his mind just as it appears before you.

The man who arranges the types, or sets them up, is called a *compositor*. He works in a light, airy room with several other compositors. Before him is a wooden frame about four feet high, and on this are two cases containing the types. The cases are wooden trays divided by strips of wood into a number of compartments. They are fixed in a sloping position like the top of a desk. Each compartment is called a box, and each box contains types of the same letter. Thus one box will be filled with the letter "a"; another with "b", and so on. The boxes are not all of the same size. That for types of the letter "x" is a small one, because this letter is seldom required. The largest box is for the letter "e". The upper case contains the capital and small capital letters, and the lower case contains the small letters.

There are many sizes of types. When you were "tiny tots" you read picture books which had very big letters. The letters in the book before you are smaller than those of your picture books, but larger than those used for newspapers. The compositor has a name for all the sizes of type.

Do not think the compositor has an easy task. His work requires long training, and a very quick eye. Probably some of my young readers have toy sets of types, and if so, they know that it is difficult to "set" even a few words. Picking out the types is quite as hard to the beginner as picking out the notes of music when one is learning to play the piano.

When the compositor is setting the type, he holds in his left hand a *composing stick*. This is a small metal tray, and at one end there is a sliding bar so that the tray may be made as wide as it is intended to make the page. He grasps the composing stick in the hollow of his left hand, and his thumb keeps the types close to each other. Suppose he has to set up the two words

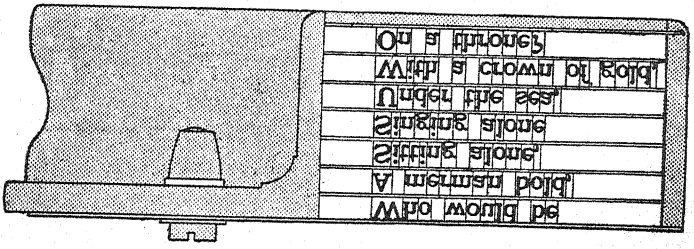
BIRDS SING.

This line is made up entirely of capital, or "upper case", letters, with a space between the words, and a full stop at the end. The first letter is **B**; so with the forefinger and thumb of the right hand he picks **B** out of its box and places it in the stick. Near the foot of the type is a groove which runs right across it. This is called a "nick", and the compositor places the types in the composing stick with the nicks uppermost. The nicks tell him that the types are arranged properly.

The next letter is **I**. This is placed in the stick next to **B**, and the remaining letters **R D S** follow in their order. Between the two words a *space* is required. This is made by placing after the letter **S** a piece of metal which is not so high as the types, and which has no face. When the types are printed, this piece of metal will give no impression. The letters **S I N G** follow the space, and the full stop is then inserted.

This may seem very simple work, but you would

be surprised at the mistakes you make if you try to set up a few words. Some of your letters would probably be turned the wrong way; others would perhaps stand with their feet where their faces ought to be. It is certain that you would sometimes forget to insert the spaces and stops. For a long time you would not be able to read the types in the composing stick, for everything seems upside down. Try to read the lines shown in the composing stick in this illustration:—

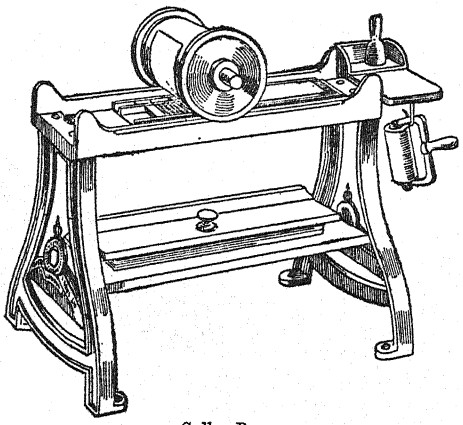


Composing Stick with Type ready for transferring to Galley

Just glance down the ends of the lines on the page before you, and contrast them with the ends of the lines in your exercise books. You will see that the print exactly fills the line in most cases. It is very different in a page of manuscript. Between some of the words on this page there are wider spaces than between others. This is because the compositor wants to finish the line without having to divide the last word.

Just before his stick is completely full of type, the compositor must empty it. Close by him he has a

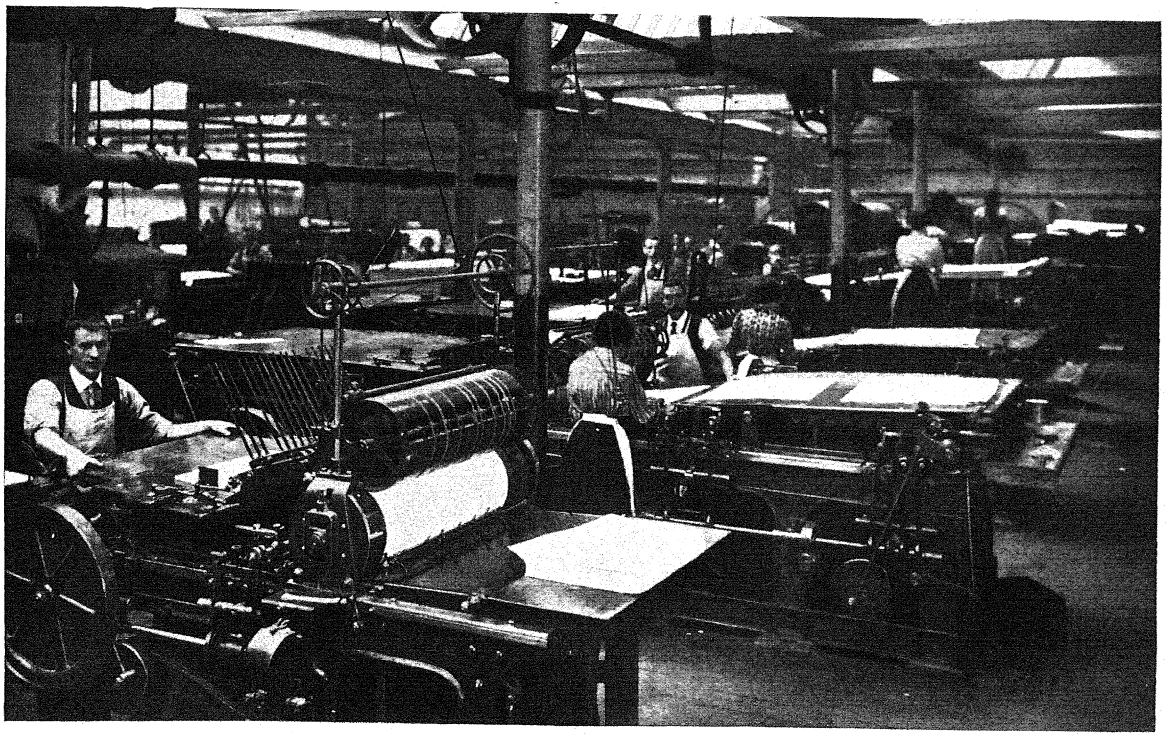
much larger and longer tray called a *galley*, and on this he places the types from the stick. It is a very hard task to lift the types to the galley so that none of them is dropped, and it requires a great deal of practice to do this properly. When the types are laid on the galley they are pushed up to the top and made fast. The compositor then fills the composing stick from fresh copy. Stickful after stickful is added to the galley until it is filled.



Galley Press

When the galley is filled, it is taken to the *galley press*. This is a very simple printing machine worked by hand. The bed of the press rests on a framework about four feet high. The galley is laid on the bed and the type is inked. A long sheet of printing paper is laid on the type, and over this a heavy cylinder is rolled so that the paper is pressed on the type, and an impression is left on the paper.

There are several kinds of galley press. The one we have described is called the Roller Galley Press.



THE MACHINE ROOM

Where books of all kinds are printed

CHAPTER XII

Printing the Book

An impression taken on the galley press is called a *proof*, and the proof is said to be *pulled*. There are many mistakes in first proofs, or galley proofs as they are often called. The man who points out these mistakes is called a *printer's reader*. He shares a little room with a boy who is known as a *reading boy*. If you wish to enter a printing work as a reading boy you should practise reading aloud on every possible occasion.

The boy reads from the copy, while the reader has the galley proof in front of him and marks any errors. What a number of mistakes there are! Words spelled wrongly; stops omitted; inverted letters; quotation marks left out; crooked lines; bad spacing; battered types; and many other errors have to be put right. The reader's sharp eyes must miss nothing. He notes the mistakes by special signs marked on the wide margin of the proof. It takes him some time to learn all these signs.

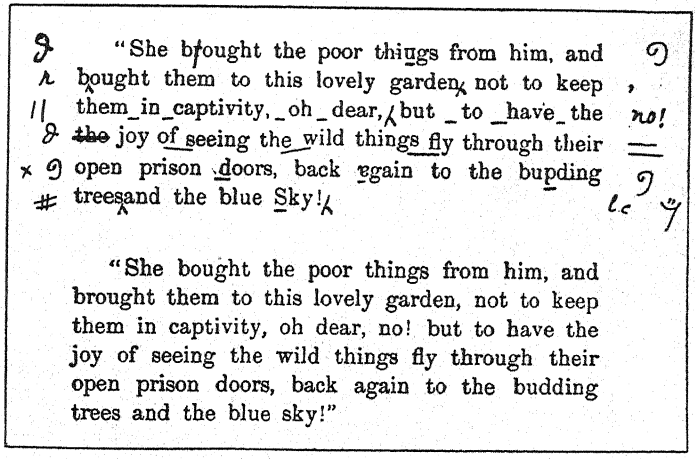
In the reader's room there are many books of reference, such as dictionaries of different languages, and other works to which he may have to refer. The reader must be a good speller, and he must

also know when and where to insert the stops. It requires great attention and much practice to detect some mistakes, such as

p (d turned) for p,
n (u turned) for n,
b (q turned) for b.

When the reader has marked the galley proof he returns it to the compositor, who then takes the galley of type and carefully corrects all his mistakes.

After all the errors have been corrected, another proof is pulled and taken to the reader along with the first proof which he marked. This second proof is called a *revise*. The reader compares the two proofs to see if the compositor has made all the



"She bought the poor things from him, and brought them to this lovely garden, not to keep them in captivity, oh dear, no! but to have the joy of seeing the wild things fly through their open prison doors, back again to the budding trees and the blue sky!"

A Portion of Corrected Galley Proof, and the Revise with the Corrections carried out

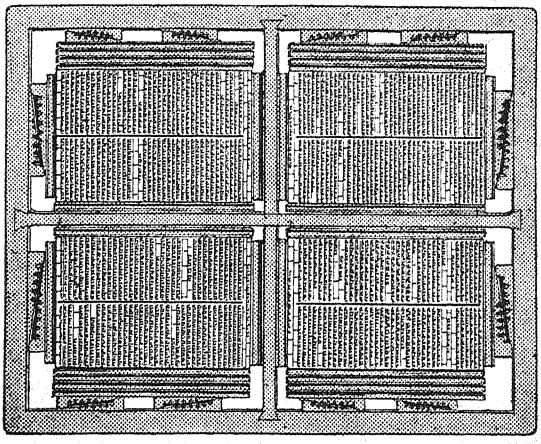
corrections. If the revise has only a few errors it is sent to the author along with the manuscript, and any additions or corrections which the author desires are now made. When this is done, the author returns the proofs to the printer, who sends them to the composing room to have the *author's revise* corrected.

The next operation is to divide the type into pages. If an extra space is wanted between the lines of type, space-lines, or *leads* as they are called, are dropped between the lines. Then the number of lines required for each page is counted off, and the *headline* is set up and put at the top of the page.

The pages are now ready for *tying up*. A strip of cord is tightly wound round and round the types, and it is fastened by pushing the loose end of the cord under the different layers, so that no knot is required.

When the type has been successfully tied up, it is pushed on to the *imposing table* or *stone*. After a certain number of pages are collected on the stone, they are put in such an order and position that when these pages are printed on a sheet of paper, the latter can be folded to form part of the book. They are locked up in a *chase*, which is a strong iron frame large enough to go round these pages. Between the chase and the sides of the type pieces of wood are fixed, and wedges, called *quoins*, are inserted between the chase and the wood so that the type is squeezed up and made secure. The locked-up type is known

as a *forme*. The compositor has to be sure that the types in the frame are all of the same height. To do this he *planes* the forme by placing a piece of hard smooth wood over the face of the type and striking the wood with a mallet.



A Forme, consisting of type pages locked up in a chase

A proof of the forme is pulled on the *hand press*, and mistakes in it are marked by the reader, who then sends it to the author. Should the author wish to make any additions to his work at this stage, it is rather awkward for the printer. An example will show why this is so. On each full page of this book there are thirty lines. If the author inserts fresh matter which requires three or four lines of type, and does not make room for it on the page by cutting out an equal amount, the printer will have

to alter all the following pages as well as the one containing the new matter.

After the author has corrected the page proofs, it is possible that he will not see the work again until it is sent to him as a bound book. But a great deal of work has still to be done before the book is ready for the bookbinder.

Perhaps you know that a book is a collection of sheets of paper folded to form leaves. These sheets are of many sizes. One sheet which measures $13\frac{1}{2} \times 17$ inches is called *Foolscap*; another, 15×20 inches, is *Crown*; *Demy* is $17\frac{1}{2} \times 22\frac{1}{2}$ inches.

In many advertisements of your prize books, and other books too, you frequently see "Crown 8vo". This means "Crown Octavo". Suppose we take a sheet of Crown paper, which we have seen measures 15×20 inches. By making one fold and halving the longer side we have two leaves, measuring 10×15 inches. This is called *folio*. If we now make one more fold at right angles to the last we get four leaves or eight pages, each measuring $7\frac{1}{2} \times 10$ inches. We have divided the sheet into four, and each part is called *quarto*. If we give it still another fold at right angles to the second, we shall get eight leaves, or sixteen pages, each measuring $5 \times 7\frac{1}{2}$ inches. This is *octavo*, and it is called *Crown Octavo* because it was a Crown sheet which we folded.

Have you ever noticed that the odd pages of a book are always on the right-hand side of the book, and the even pages on the left-hand side?

In nearly all books there is a letter at the foot of certain pages, and a little further on there is another letter. These letters follow in order throughout the alphabet, with the exception of J and V. The reason that J and V are omitted is that when *signatures*, as these letters are called, were first used, the I and J and the U and V were so much alike that a mistake might easily be made. Numbers are often used instead of letters for this purpose.

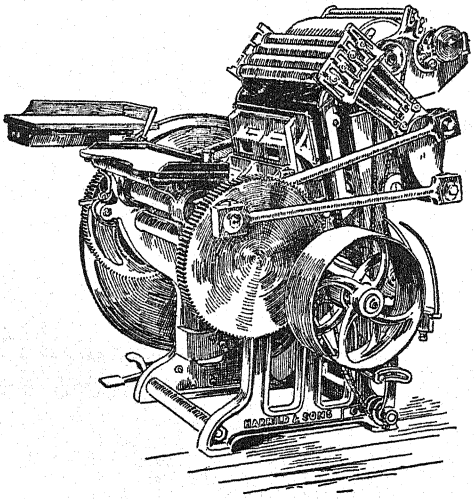
If you count the number of pages between the letters, you will find that they are the same in every case. In an octavo book the letter B will be found at the foot of page 17. Thus there are sixteen pages before this, which is known as the title signature or signature A. C will appear at the foot of page 33; D on page 49; and so on. So you see that the signatures are on the first page of each fresh sheet.

There are several reasons why signatures are used. They assist the bookbinder in collecting the sheets so that they follow in proper order. If the letters follow in their proper order he can tell at a glance that his sheets have been properly collected. Printers, too, refer to the sheets by their signatures. Suppose something has to be done to sheet N. The printer at once looks for page 193, which is the first page of sheet N. You can easily see why this should be so, by counting up the letters to N—of course omitting the J—and multiplying the number by 16.

The reader carefully examines the proofs in sheets to see if the signatures are correct, if the headlines

have been printed in their proper position, and if the pages are numbered correctly.

After this has been done, and the necessary corrections made, the sheets are ready for the press. A press revise is pulled, and sent to the press reviser



Platen Machine

for correction. When this is done he marks the sheet "For press", and generally inserts the number of copies to be worked.

There are many kinds of printing machines. All book printing is done by *cylinder machines*; but handbills, circulars, and similar small articles are often printed on *platen machines*. In a cylinder machine the sheet of paper is carried round a revolving cylinder and pressed against the inked forme

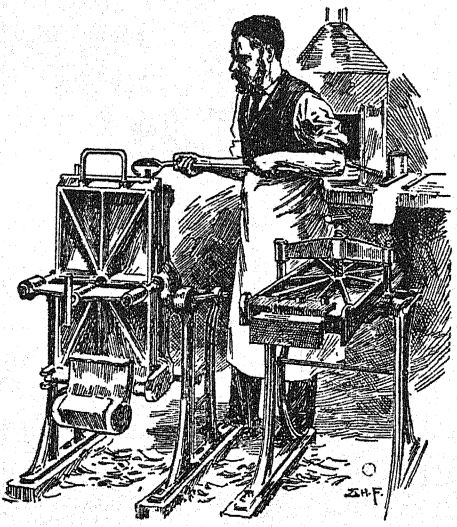
of type, which moves backwards and forwards in the bed of the machine. The forme of type has its surface uniformly inked by passing beneath inking rollers at the ends of the machine. In a platen machine the sheet is carried by a flat surface called the *platen*, which brings it into contact with the type. Some cylinder machines print only on one side of the paper at a time, but others print both sides during the one movement through the machine. The latter are called "perfecting" machines, because they finish the printing of the sheet at once.

You would be highly interested in watching a printing machine at work. When it has been started it will run so smoothly that the only work man has to do is to feed it with sheets of paper. A boy or a girl feeds in the paper, while the man who looks after the machine, called a *machine-minder*, attends to the inking arrangements to see that the sheets are printed neither too black nor too grey.

In some cases the forme is lifted from the imposing table and fixed on the bed of the press. But it often happens that books are printed, not from the types themselves, but from casts taken from them in the foundry. In this case, the type is fixed in a strong iron frame called a *foundry chase*, and sent to the foundry. A mould of the type is taken in beeswax, and from this mould, by the help of an electric current, a copper shell is obtained which is an exact duplicate of the face of the page. The shell is backed with lead to give a plate of one-sixth of an inch thick,

and this is mounted on wooden or metal blocks to make it the same height as type when on the printing machine. The electrotype casts, or *electros* as we should call them, are solid plates; so you see that the letters on the plates cannot drop out as those in the forme may do. When all the sheets have been printed, the printer can stack his electros on shelves, ready for future use if required.

Another method of making plates to print from is by *stereotyping*, which is simpler and cheaper than electrotyping. A mould is made from the chase of type in papier mâché, a kind of paper pulp, and from this there is cast directly a plate of type metal, called a *stereo.*



Stereotyping

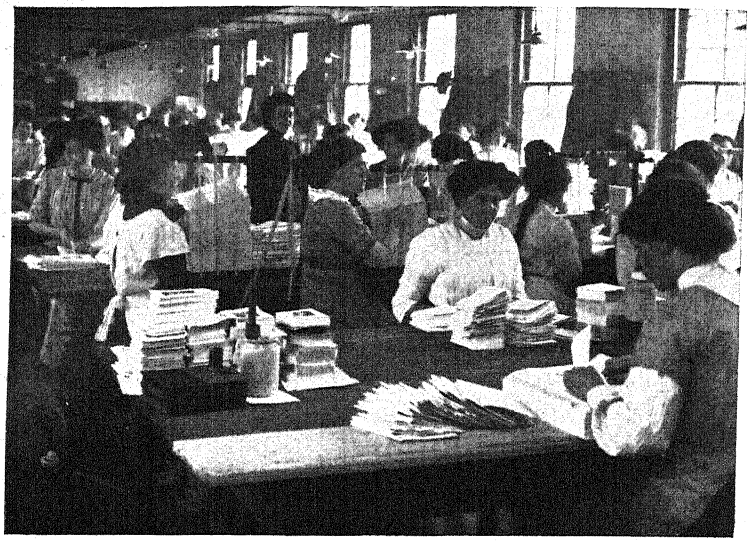
CHAPTER XIII

The Bookbinder and his Art

In the last chapter we saw how the complete edition of the book was "worked off". Thousands and thousands of clean printed sheets are stacked in the warehouse, all in their proper order. The great value of signatures is seen at this stage. Suppose there were 10,000 copies in the edition. Then we find 10,000 sheets of the title signature, followed by 10,000 sheets of signature "B", 10,000 sheets of "C", and so on, through the alphabet, with the exception of "J" and "V". You can imagine what a jumble there would be, when the sheets were sent to the bookbinder, if this order were not kept.

The first operation in bookbinding is to fold the sheets—into two leaves if the book be folio; into four, if quarto; into eight, if octavo (see page 70). After the sheets are folded they are arranged in their proper order, so as to make up the complete volume, and the plates or maps, if any, are pasted at their proper places. This work is generally done by girls.

When the sheets of the book have been collected and placed in their proper order, the volume looks very bulky. It is generally passed through a rolling machine, which "mangles" the sheets, so that they are pressed very closely together, and the book is



BINDING THE BOOK

At the top are shown girls folding the sheets and sewing on the tapes by hand. The lower picture shows sewing by machinery

made firm and hard. In some cases a screw or hydraulic press is used for this purpose. Years ago the bookbinder beat the sheets on a smooth stone with a very heavy hammer.

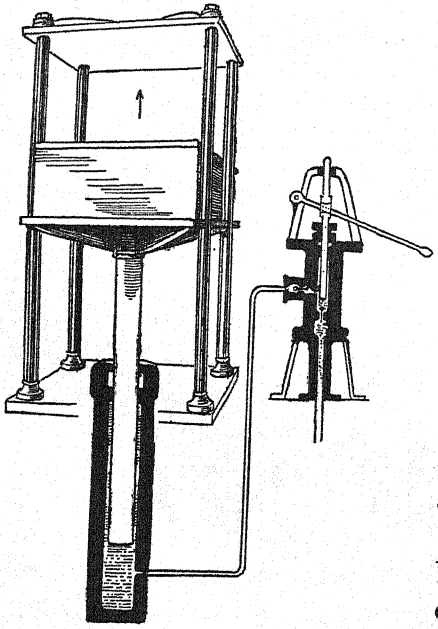
If the volume has many hundreds of pages in it, it is split up into three or four parts, and each part is placed between smooth hardwood boards and pressed for several hours.

After the sheets have been pressed as firmly as possible so that they are smooth and hard, they are passed on to the *sawing table.* Here there are three or four circular saws which project slightly from the table, and these make from three to five shallow cuts across the back of the book. Into these cuts the cords on which the book is to be sewed are inserted. In cheap books the sheets are sewed on tapes fastened on the back of the book, so that sawing is not required. The cords and tapes project on each side of the back, in order that the covers may be laced by them.

The book now passes on to the *sewing bench.* Here the sheets are attached to the cords or tapes by strong thread or twine. This is now usually done by means of ingenious machines. The next stage consists in pressing the volumes again, and then the edges are cut or trimmed by a machine called a guillotine.

The adornment of the edges is the next operation. Some books have gilt edges, whilst others are marbled, sprinkled, coloured, or left white. In gilding,

the edges are made quite smooth, and then coated with size made from white of egg, after which they are covered with gold leaf. The gold is then burnished with a burnisher of ironstone, followed by one of agate. Burnishing is now, however, often done by a machine. Marbling is performed by dipping the edges into the colouring mixture as it floats on gum water. Sprinkling is done by dipping a brush in the colouring solution, and shaking small drops on the edges.



Hydraulic Press
showing the working parts in section

The back of the book is then covered with a coating of strong glue. The glue stands until it is quite dry and hard. In order to round the back of the book, it is then beaten by a flat-faced hammer. The volume next undergoes the operation called *jointing*. It is placed in a horizontal press, which contains a pair of hardwood boards that are firmly pressed on the sides of the book, but which are

kept one-eighth of an inch from the edge of the back. The back is beaten so that it projects a little over the boards that compress it, and a groove or *joint* is formed as a sort of hinge for the boards to open and shut in.

The cloth case or cover of a book consists of two pieces of millboard, which is a stout kind of pasteboard, covered with cloth. The case is prepared by gluing the inside of the cloth, and then placing on it in proper position the two boards, with a piece of stout paper between them to go round the back of the finished volume. The corners of the cloth are then clipped off, and the projecting edges are folded in and glued down. When the case is dry, the title of the book and the ornaments to go on the cover are stamped on in gold leaf by means of hot brass dies specially cut for each book.

If the book is to have a leather binding, the cover is first damped, and the inside smeared with strong paste. It is then pulled on the book and doubled over the edges of the boards. After the sides and edges are made square, the book is put for some hours in a press. Any letters or designs that may be wanted are now made by hand with brass tools.

Cloth cases are fastened to the jointed book by strips of coarse thin canvas, which are glued to the back of the book and project from half an inch to three-quarters of an inch on each side. These strips are glued to the covers. To hide them, and give

a neat finish, some white or tinted paper is glued in.

Years ago, nearly all the work of bookbinding was done by hand, but nowadays machines are used in most of the operations. So rapidly do the machines work that 1000 copies of an octavo book can be bound in six or seven hours.

. . . . . .

And so, at last, our book is complete! What a number of changes it has passed through! Right from ragbag, esparto field, or lumber camp, we have traced its history. Thousands of busy hands have worked upon it; engines have clanked, and machines have whirred and whizzed in its making.

But now, all is over! There it stands on the bookshelf, side by side with dozens of other old fellows, all dressed in their leather, cloth, or paper jackets. It seems to speak to us, and invite us to read what is in its pages. You read it now and enjoy its story. Perhaps when you grow up, you will still turn over its well-thumbed pages, and go back once more into childhood's days.

Treat it carefully; treat it gently. For it is a constant companion and tender friend.
